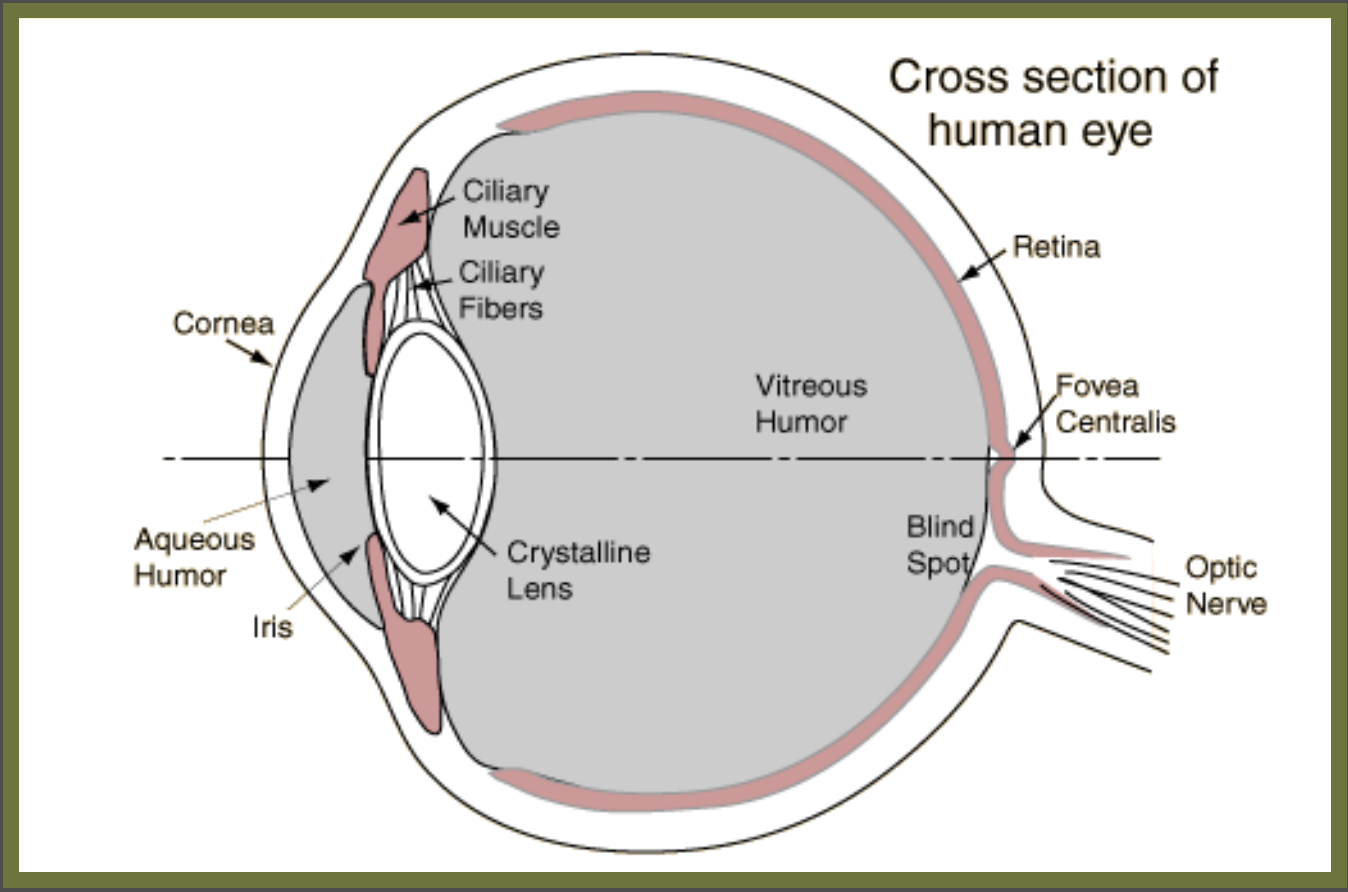
NIGHT VISION ORIENTATION

TERMINAL LEARNING OBJECTIVE

- Action: Manage the effects of visual limitations during night flight
- Condition: While performing as an aircrew member
- Standard: In accordance with (IAW) FM 3-04.301, TC 1-204, FM 8-50, AR 40-501, and AR 40-8

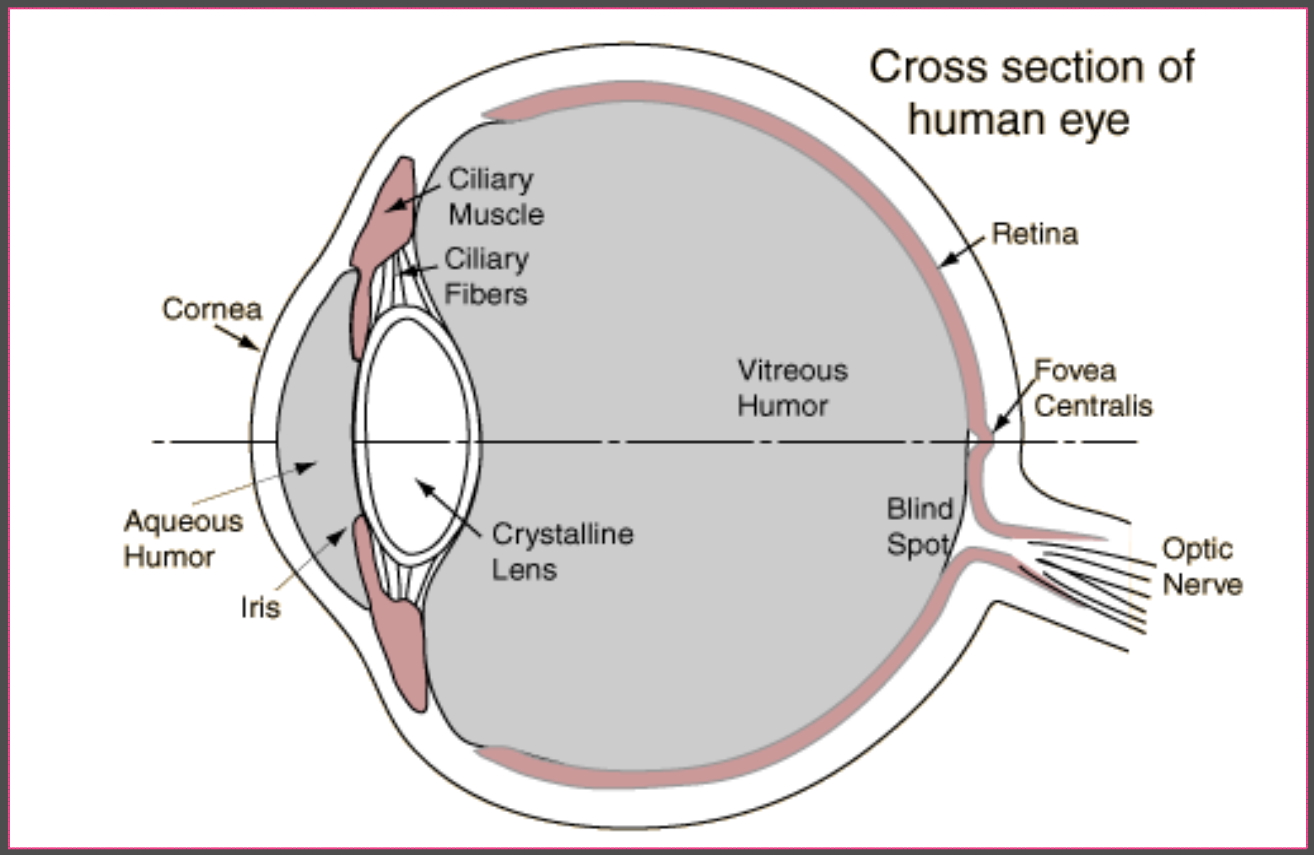
ANATOMY OF THE HUMAN EYE

CORNEA



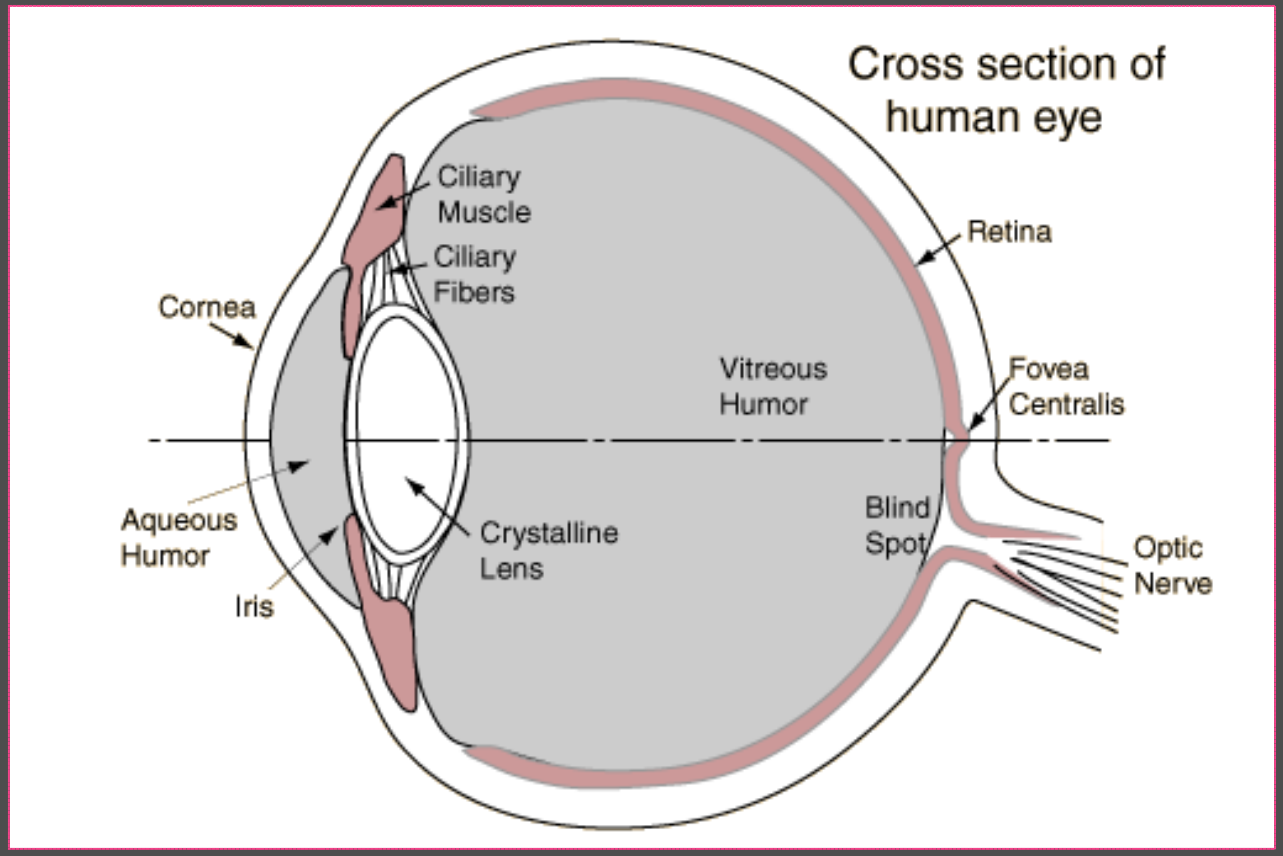
ANATOMY OF THE HUMAN EYE

IRIS



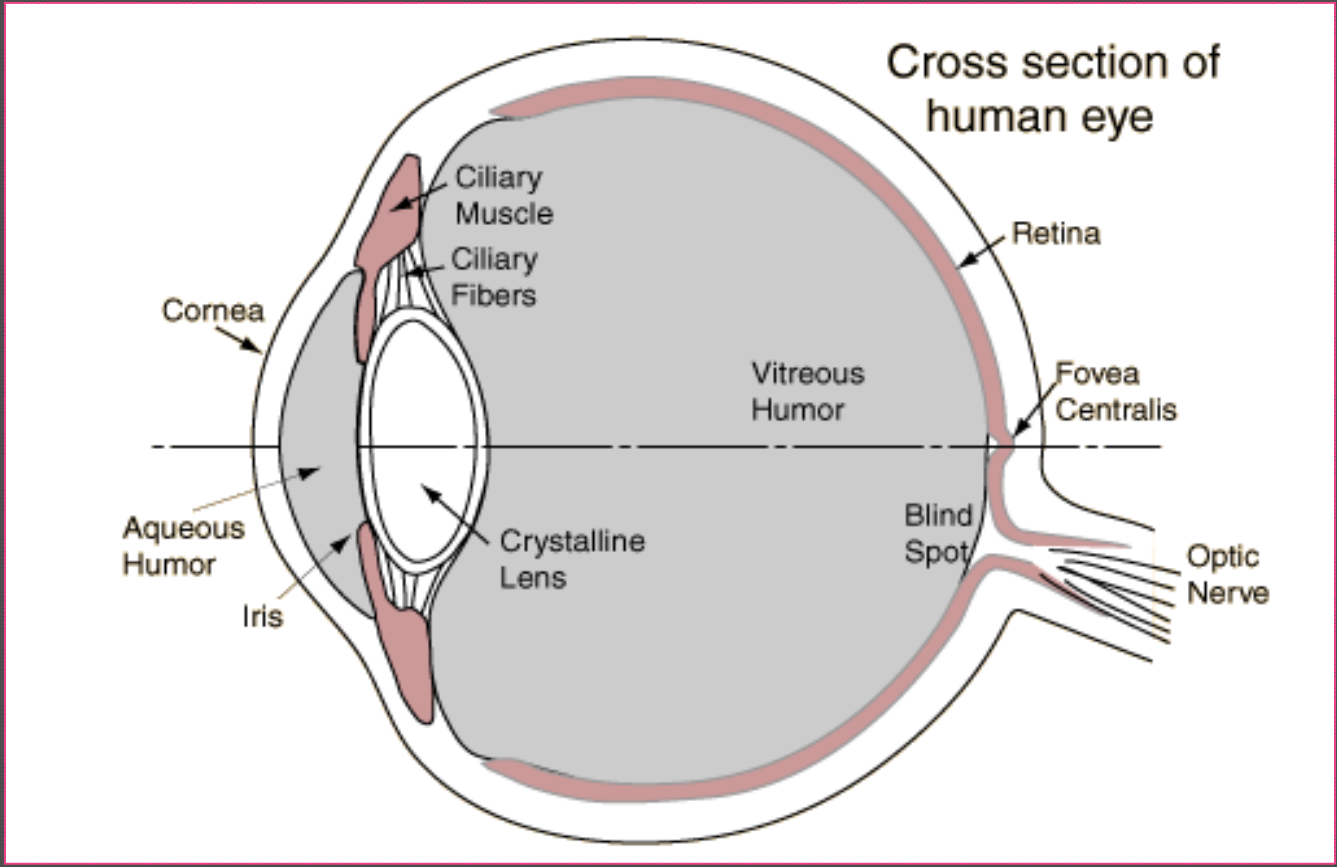
ANATOMY OF THE HUMAN EYE

PUPIL



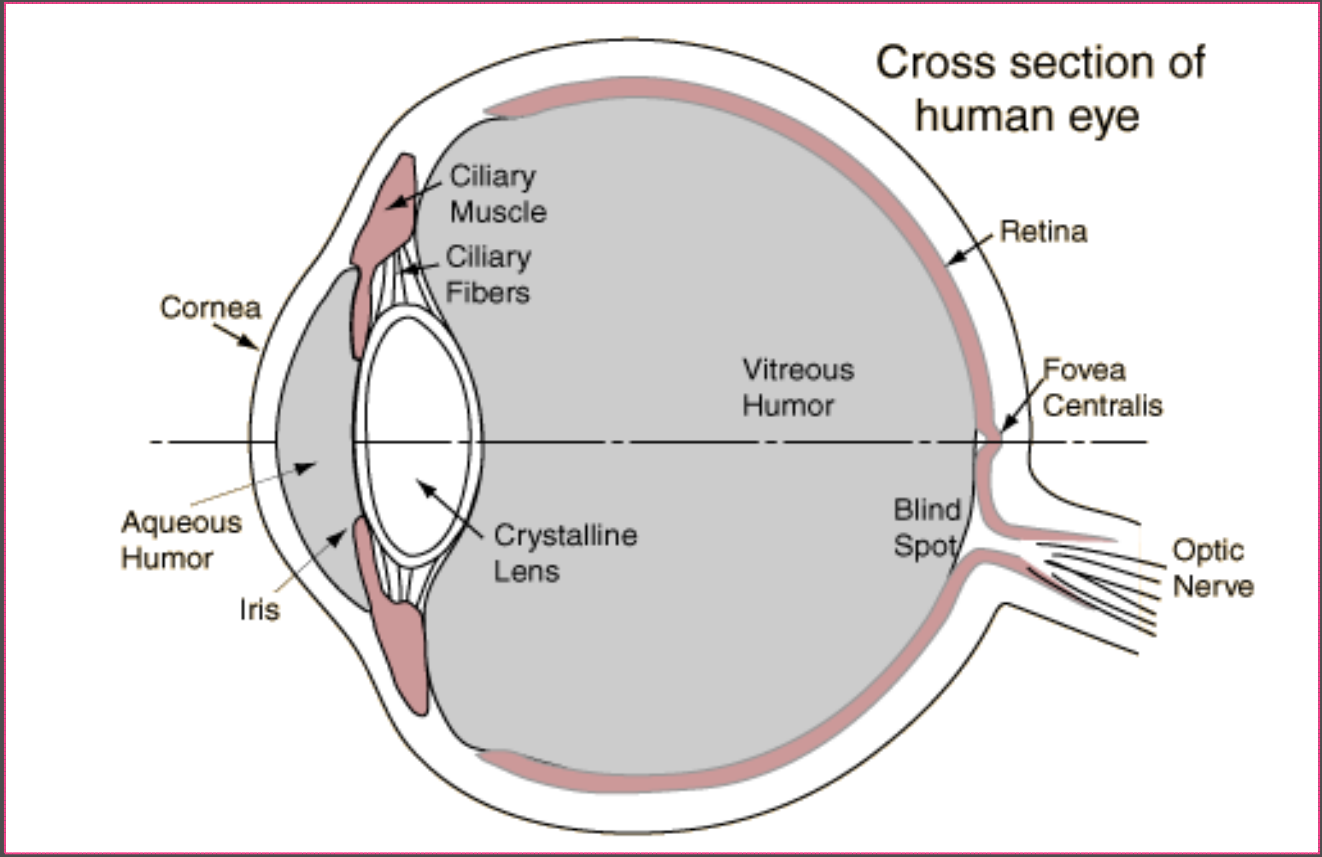
ANATOMY OF THE HUMAN EYE

LENS



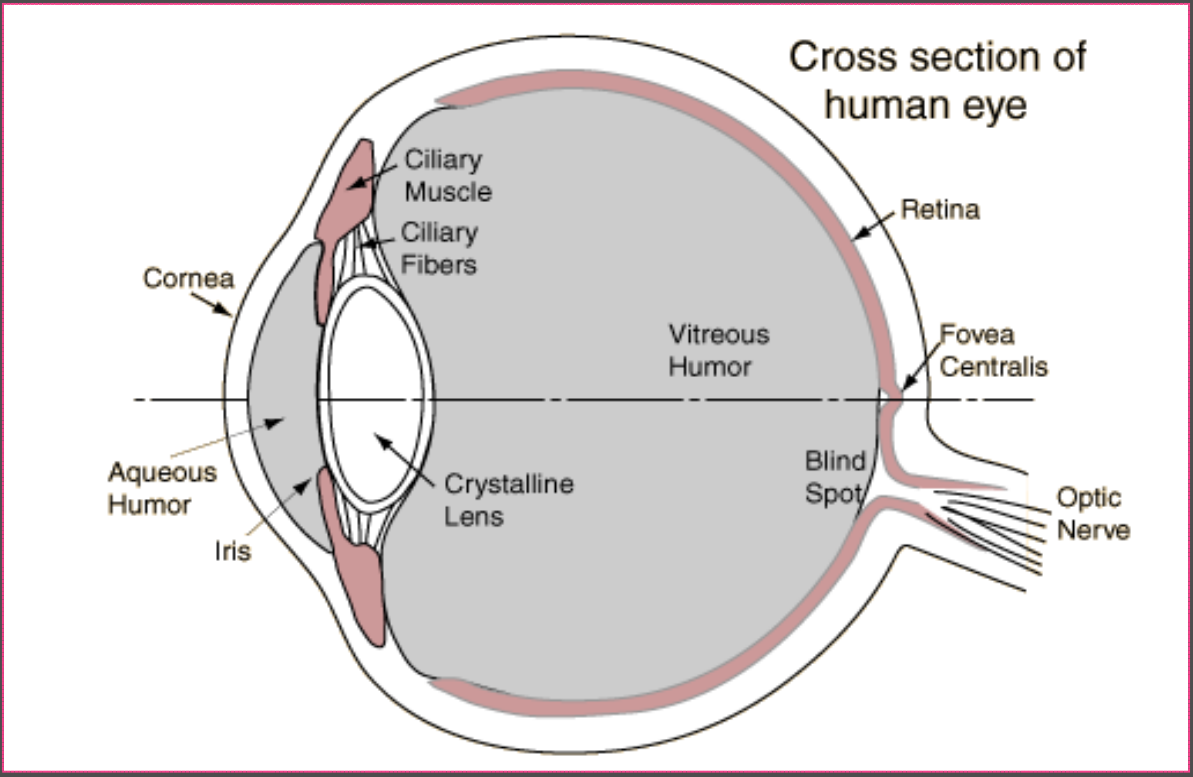
ANATOMY OF THE HUMAN EYE

RETINA



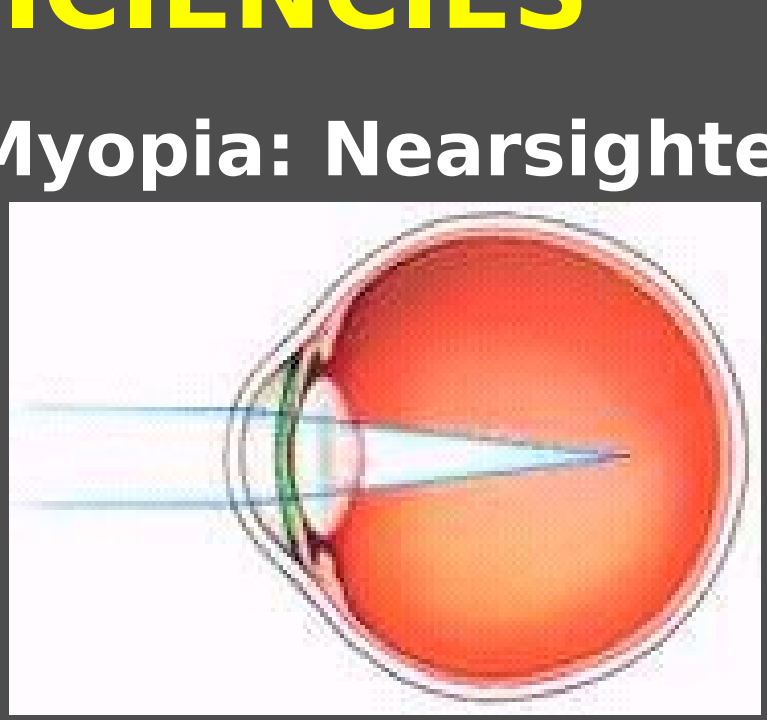
ANATOMY OF THE HUMAN EYE

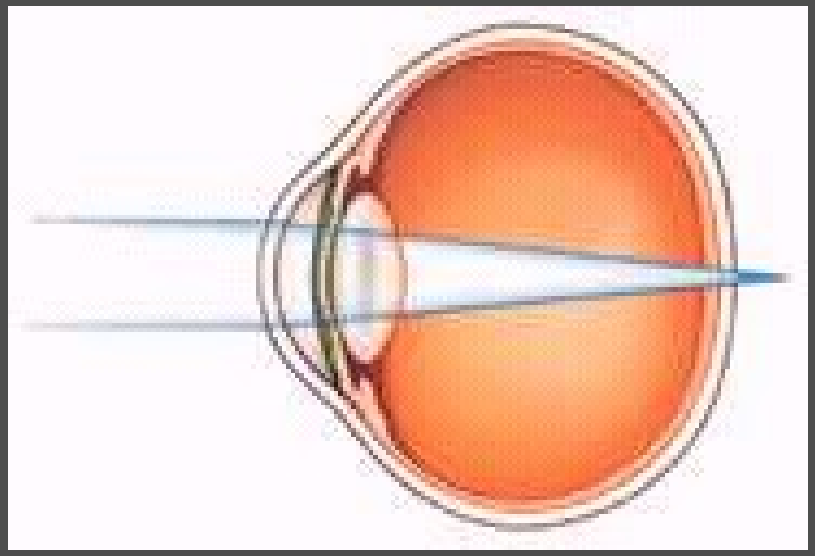
OPTIC DISC



VISUAL DEFICIENCIES

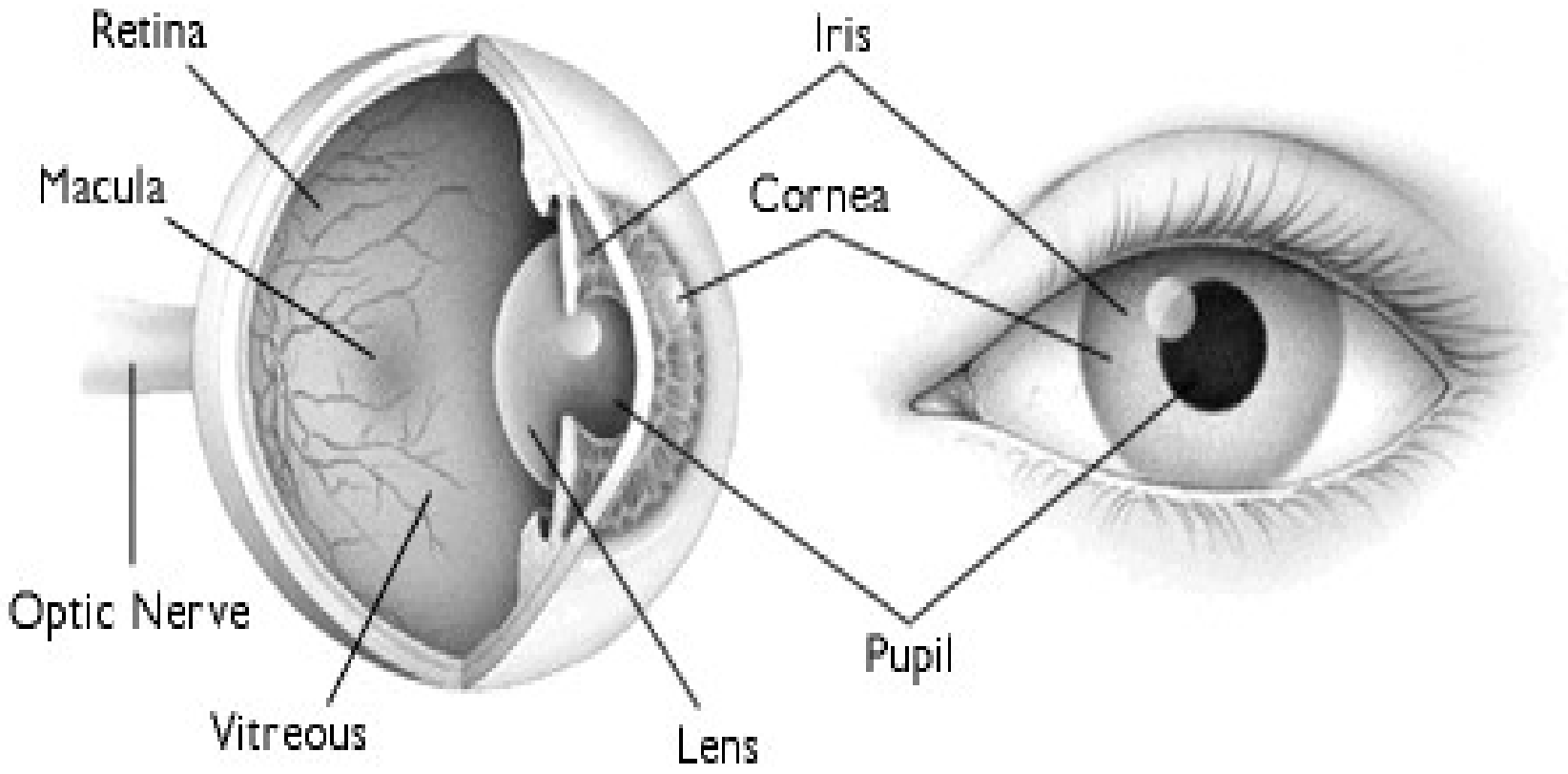
Myopia: Nearsightedne





Hyperopia: Farsightedness

Presbyopia: (aging) Hardening of lens, loss of ela


Retina
Macula
Optic Nerve
Vitreous
Lens
Iris
Cornea
Pupil

QUESTIONS !!

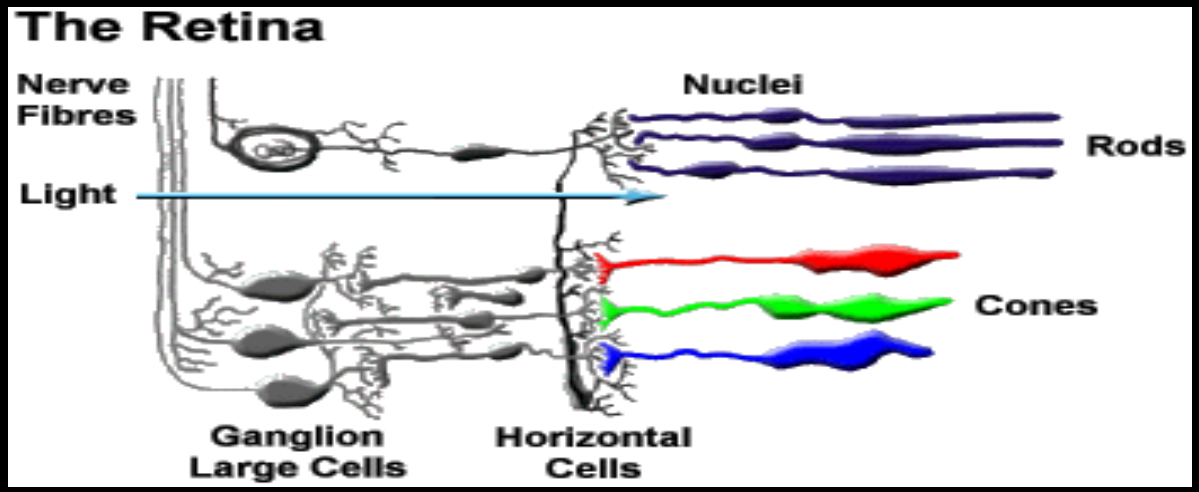
PHOTORECEPTOR CELLS

Cone cells:

- Used in periods of bright light
- Identifies colors
- Sharp visual acuity and color sense
- 7 million in fovea and parafovea regions
- 1:1 ratio of cone cells to neuron cells

Rod cells:

- Used in periods of low ambient light and darkness
- Identifies outline of shapes and silhouettes
- Poor color sense and visual acuity
- 120 million rod cells
- 10:1 to 10,000:1ratio of rod cells to neuron cells



RETINAL BLIND SPOTS

- **Day blind spot:**

  Related to position of optic disc on the retina

  Located 15 degrees from fovea

  No Photoreceptor cells

  Encompasses **5.5** to **7.5** degrees of visual field

- **Night blind spot:**

  Located in central viewing axis (fovea)

  Absence of rod cells in fovea

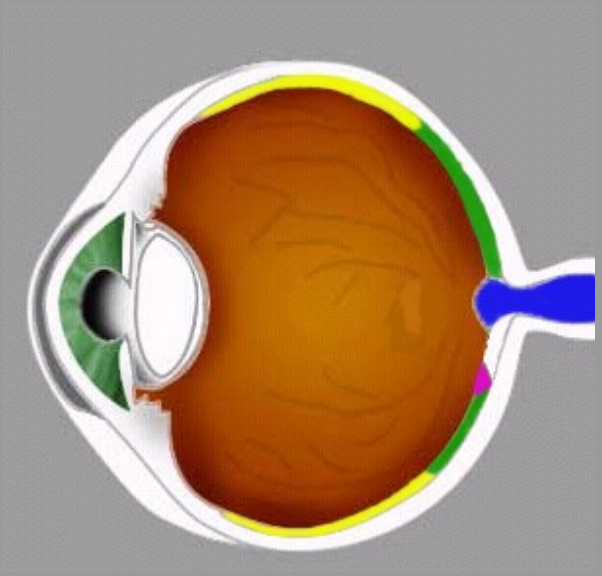
  Inability of cone cell function

  Encompasses viewing area of **5** to **10** degrees center of visual field

BLIND SPOT

- **Night**

PERIPHERAL



PARAFOVEA

OPTIC NERVE

FOVEA

PARAFOVEA

PERIPHERAL

QUESTIONS !!

MESOPIC VISION

- Dawn, dusk, and full moonlight
- Parafoveal regions (rods and cones)
- Decreased visual acuity and color sense

SCOTOPIC VISION

- Night vision (partial moon and star light)
- Peripheral vision (rods only)
- Acuity degraded to silhouette recognition
- Loss of color perception
- Off center viewing (scanning)

QUESTIONS !!

FACTORS THAT AFFECT DARK ADAPTATION

* **Photosensitivity of the eye:**
  - - Cone Cells (Iodopsin)
  - - Rod Cells (Rhodopsin)
* **Bleaching affect**
* **Poor Nutrition:** Vitamin A deficiency hinders production of Rhodopsin

QUESTIONS !!

LIMITATIONS OF NIGHT VISION

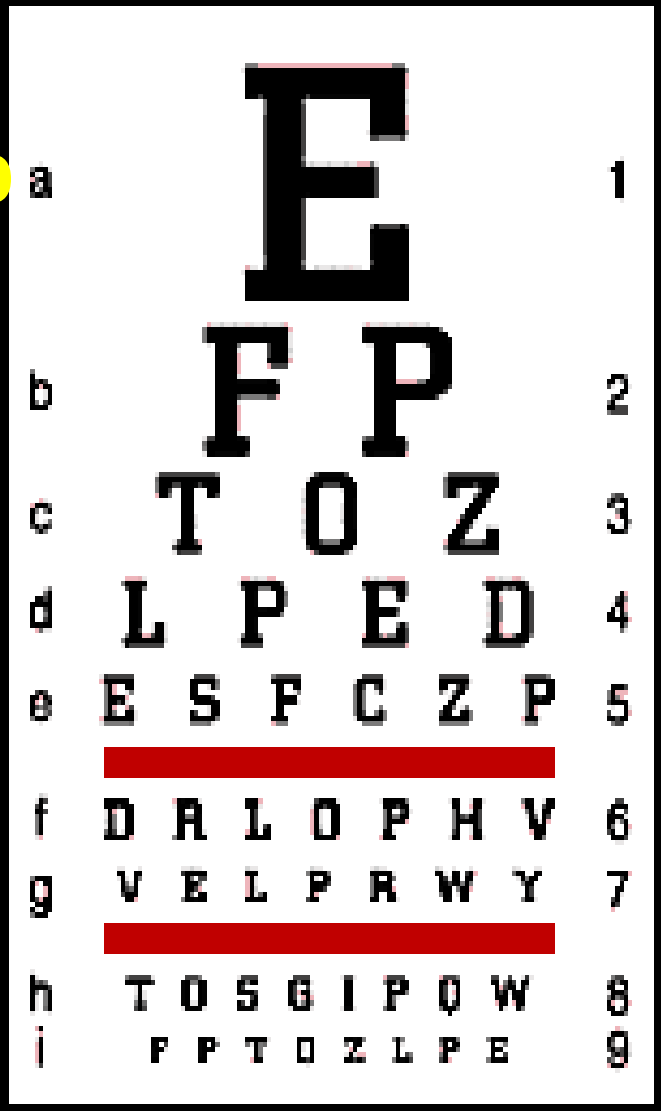
- Depth perception (safe landings)
- Visual acuity (obstacle identification)
- Night Blind spot
- Dark adaptation (time factor)
- Color Vision
- Night myopia
- Visual Cues

DEPTH PERCEPTION

- False interruption or judgment of actual altitude related to poor depth perception
- Proper crew coordination
- Use searchlight or landing light if mission permits

VISUAL ACUITY

20/200



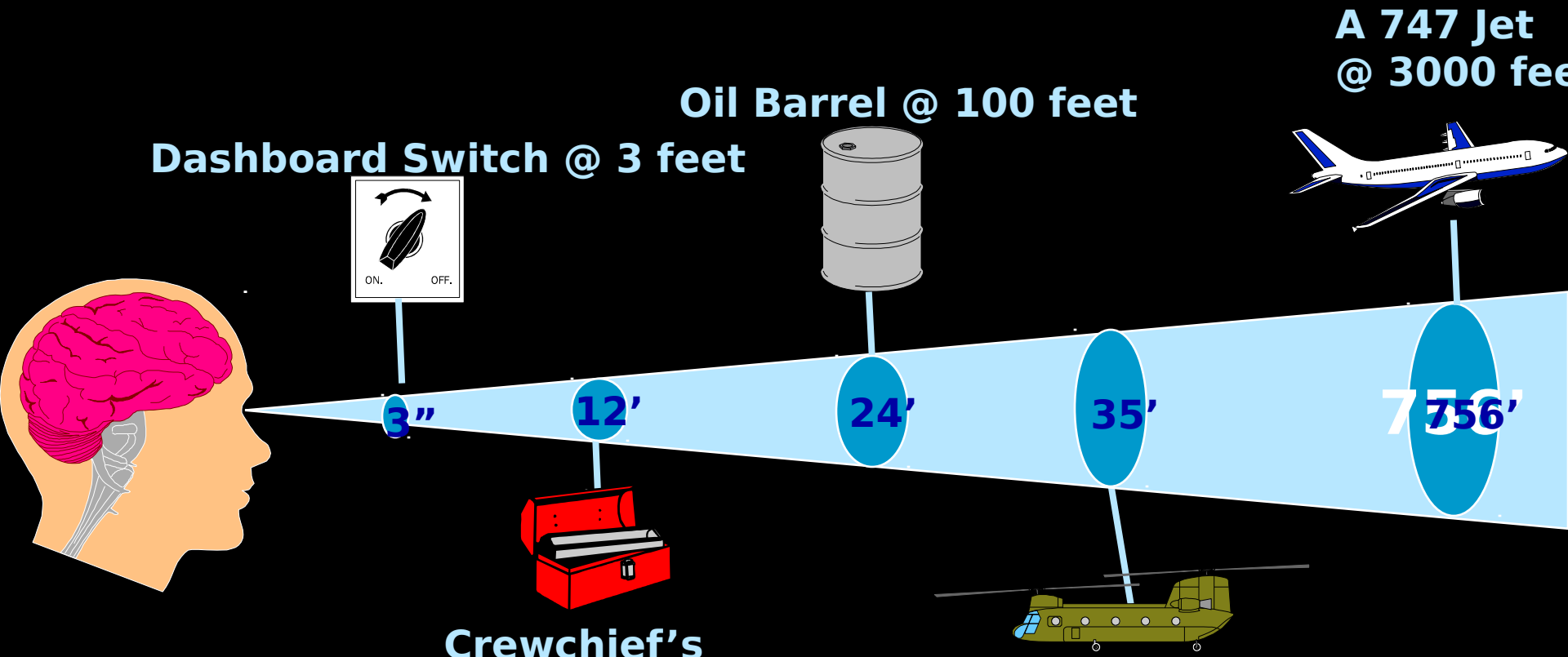
20/200

20/20

20/20

NIGHT BLIND SPOT

You may NOT see…



DARK ADAPTATION

- 30 to 45 minutes average time period (rhodopsin)
- Duration of exposure accumulative
- May increase up to 3 to 5 hours if exposed to glare off sand, snow, water, and direct sun
- Nutrition: eat a proper diet, Vitamin A (sensitivity)

DARK ADAPTATION

- Exposure of bright light or solar glare effects night vision acuity and rod cell sensitivity
- Use of red lens goggles will assist dark adaptation by reducing time requirement

COLOR VISION

Photopic

Mesopic

Scotopic

NIGHT MYOPIA

- Blue wavelength lighting causes night myopia
  - ✈ Image sharpness decreases as pupil diameter increases
  - ✈ Mild refractive error factors combined, creates unacceptably blurred vision
  - ✈ Focusing mechanism of the eye may move toward a resting position (increases myopic state)

BINOCULAR CUES

- Valuable only when object is close
- Each eye has a slightly different view
- Operates subconsciously

MONOCULAR CUES (GRAM)

- Object seen as one picture
- Are derived from experience
- Subject to interpretation

GEOMETRIC PERSPECTIVE

- OBJECTS have different shapes when viewed at varying distances and altitudes

GEOMETRIC PERSPECTIVES

Linear perspectives

Vertical position in the field

Apparent foreshortening

RETINAL IMAGE SIZE

- **K**nown size of objects
- **I**ncreasing or decreasing size of objects
- **T**errestrial association
- **O**verlapping contours

KNOWN SIZE OF OBJECTS

DECREASE IN SIZE

INCREASE IN SIZE

TERRESTRIAL ASSOCIATION

OVERLAPPING CONTOURS

AERIAL PERSPECTIVE

- Distant information gained by clarity of object viewed or by the shadow it casts

FADING OF COLORS AND SHADES

LOSS OF DETAIL OR TEXTURE

MOTION PARALLAX

- Very important cue to depth perception

  ✈ Stationary objects

- Rate depends on the distance of the object

VISUAL ILLUSIONS

- Relative motion
- Confusion with ground lights
- False vertical and horizontal cues
- Depth Perception illusion
- Structural illusions
- Autokinetic illusion
- Size distance illusion
- Flicker vertigo
- Fascination (fixation) in flight
- Reversible perspective
- Altered planes of reference
- Crater illusion

QUESTIONS !!

METHODS TO PROTECT NIGHT VISION

- Clear visor
- Adjust dashboard, rear crew compartment, and exterior lights
- Close or cover one eye
- Supplemental oxygen
- B-LPs
- Distance from laser
- Avoid bright lights
- Short ordnance burst
- Proper nutrition
- Avoid dehydration
- Search/landing light

LASER

- LASER

  Light

  Amplification

  by a

  Stimulated

  Emission of

  Radiation

LASER

- Intense, narrow beam of light, less than 1 inch in diameter
- Widens with distance: 2km-diameter is 2 meter

LASER INJURIES

Lens: Focuses and concentrates light rays entering the eye

Concentration of energy through the lens is intensified 100,000 times greater than the normal light entering the eye

LASER INJURIES

Amount of damage depends on laser type, exposure time, and distance from the laser

- **Types of injuries:**
  - Tiny lesions on the back of the eye
  - Flash blindness
  - Impaired night vision
  - Severe burns effecting vast body portions

LASER PROTECTIVE MEASURES

Passive:

- Take cover
- NVD’S
- Squinting
- Protective goggles

Active:

- Counter measures taught or directed
- Evasive action
- Scanning with one eye or monocular optics

NERVE AGENTS

- Causes **miosis** (pupil constriction)
- Pupils will not dilate during low ambient light
- Exposure time required to cause miosis:
  - ✈ Depends on agent concentration and cumulative effects of repeated exposure

NERVE AGENT SYMPTOMS

- Range from minimal to severe (dosage to eye?)
- Severe miosis may persist for 48 hrs
- Complete recovery may take up to 20 days
- Consult flight surgeon immediately

QUESTIONS !!

SELF-IMPOSED STRESSES

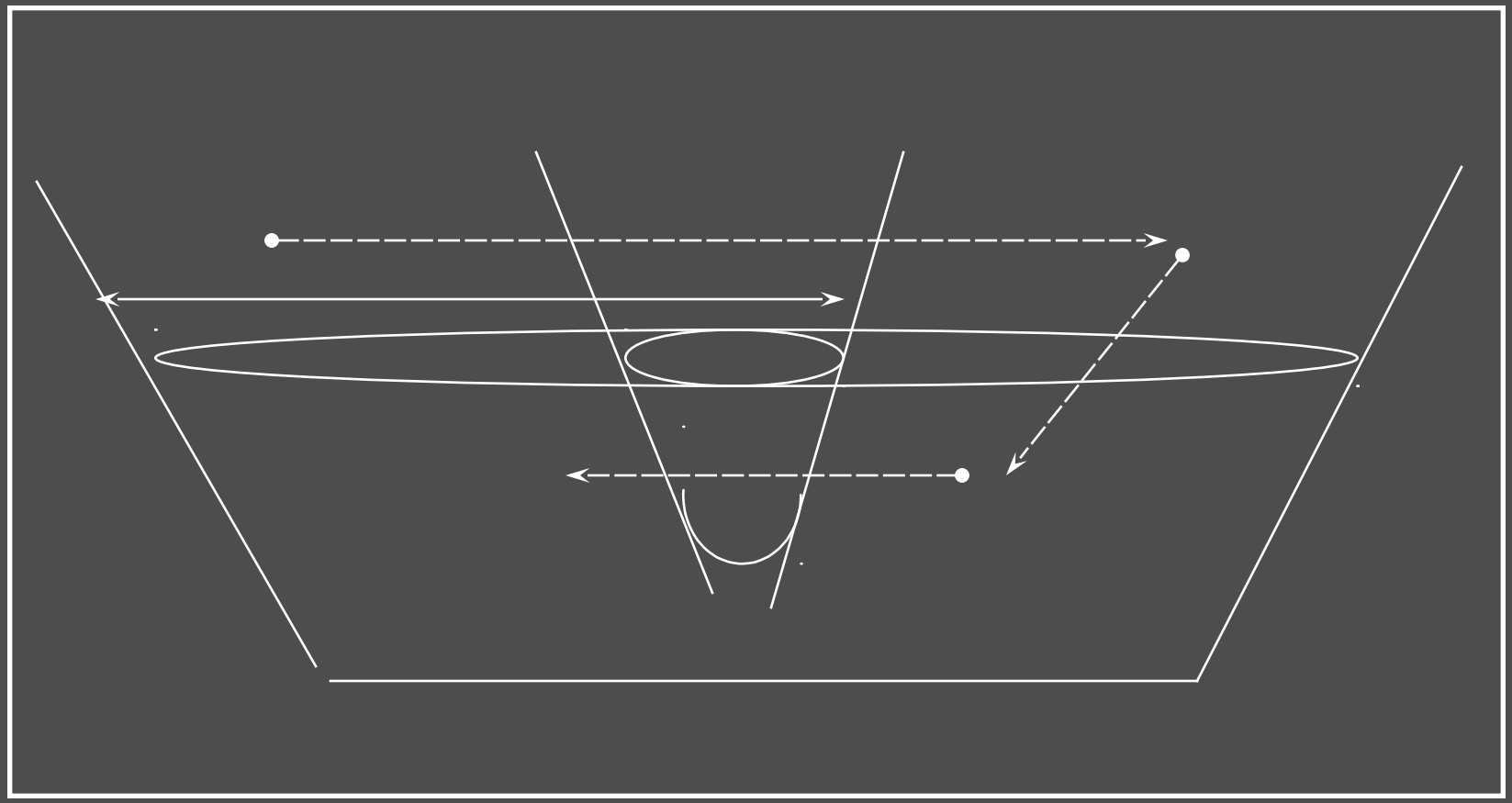
- **D**rugs
- **E**xhaustion
- **A**lcohol
- **T**obacco
- **H**ypoglycemia

QUESTIONS !!

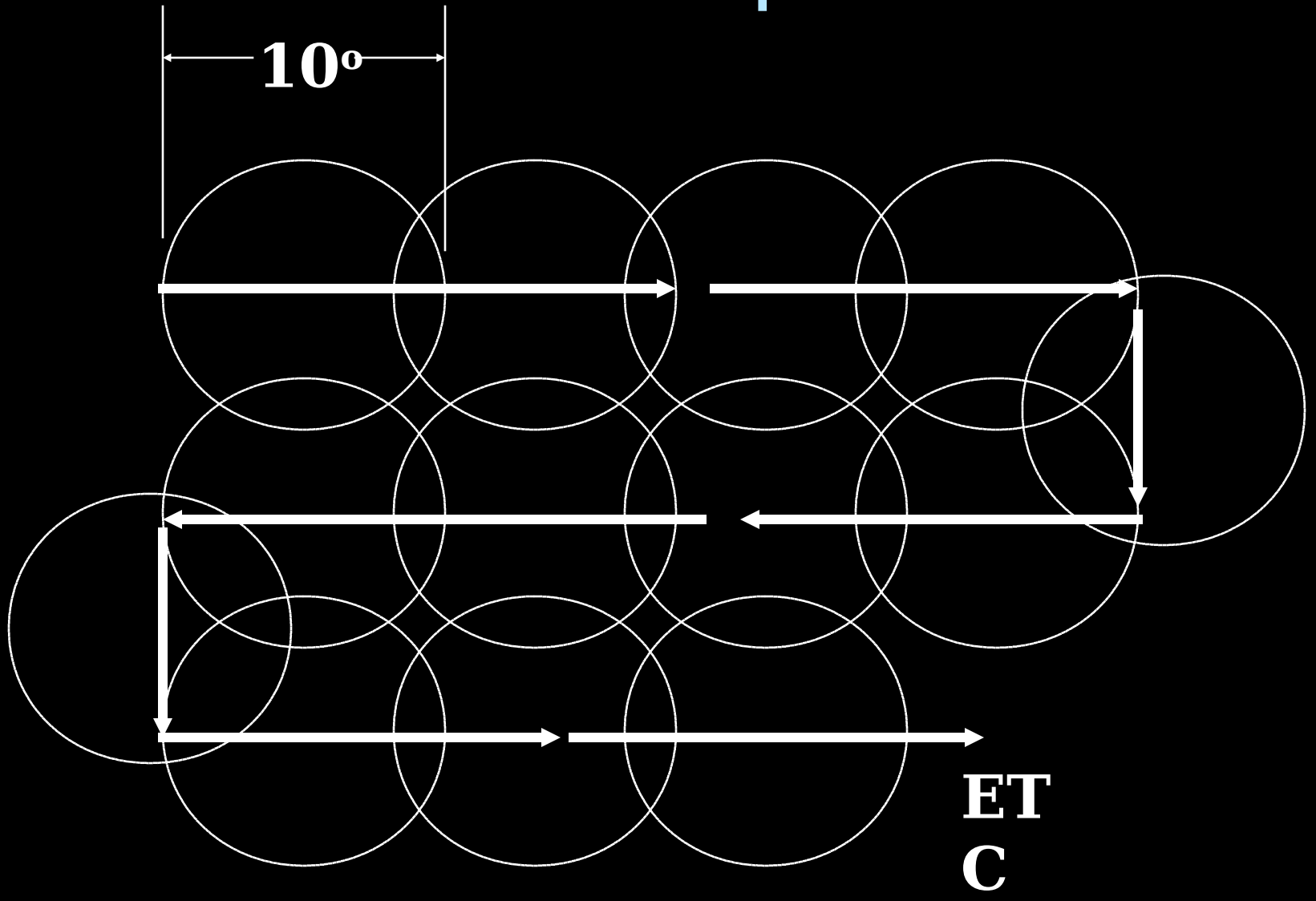
SCANNING TECHNIQUES

- Stop-turn-stop-turn technique
- Ten degree circular overlap
- Off-center viewing

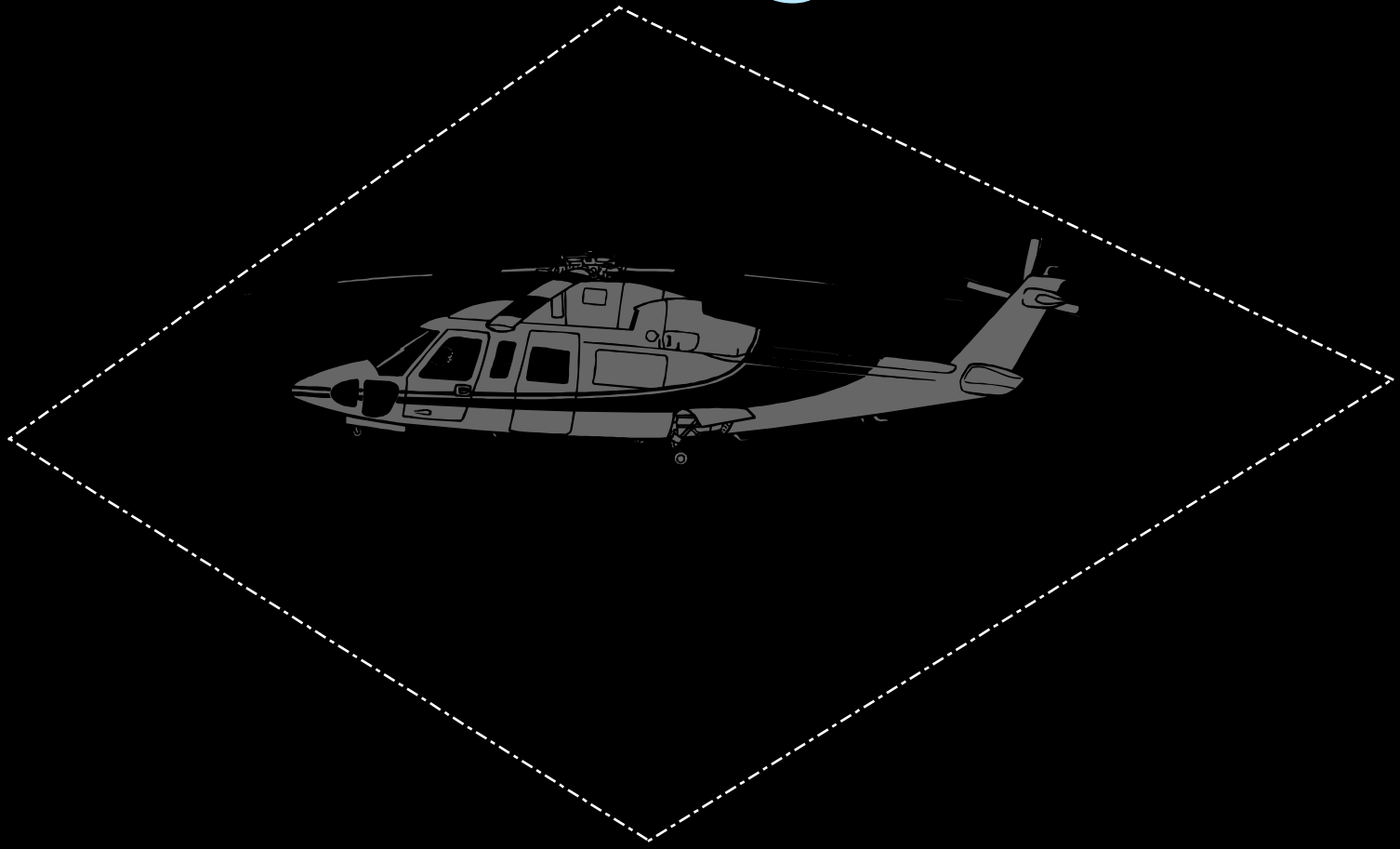
STOP-TURN-STOP-TURN



Ten Degree Circular Overlap



Off- Center Viewing



QUESTIONS !!

PHYSIOLOGICAL EFFECTS OF NVD'S

Depth perception:

- Distance estimation is reduced
- Chromatic adaptation / discoloration of objects
- Regain dark adaptation three to five minutes

Spatial disorientation:

- A/C bank greater than 30 degrees
- Rapid scan technique
- Unfamiliar perception due to lack of NVG experience

QUESTIONS !!

SUMMARY